8-A-4-K

INSTRUCTION MANUAL

MSHA APPROVED
MEETS REQUIREMENTS
OF 30 CFR PART 22

400 SYSTEM

COMBUSTIBLE GAS / OXYGEN MONITOR

GE Rental/Lease

Rental Accessory

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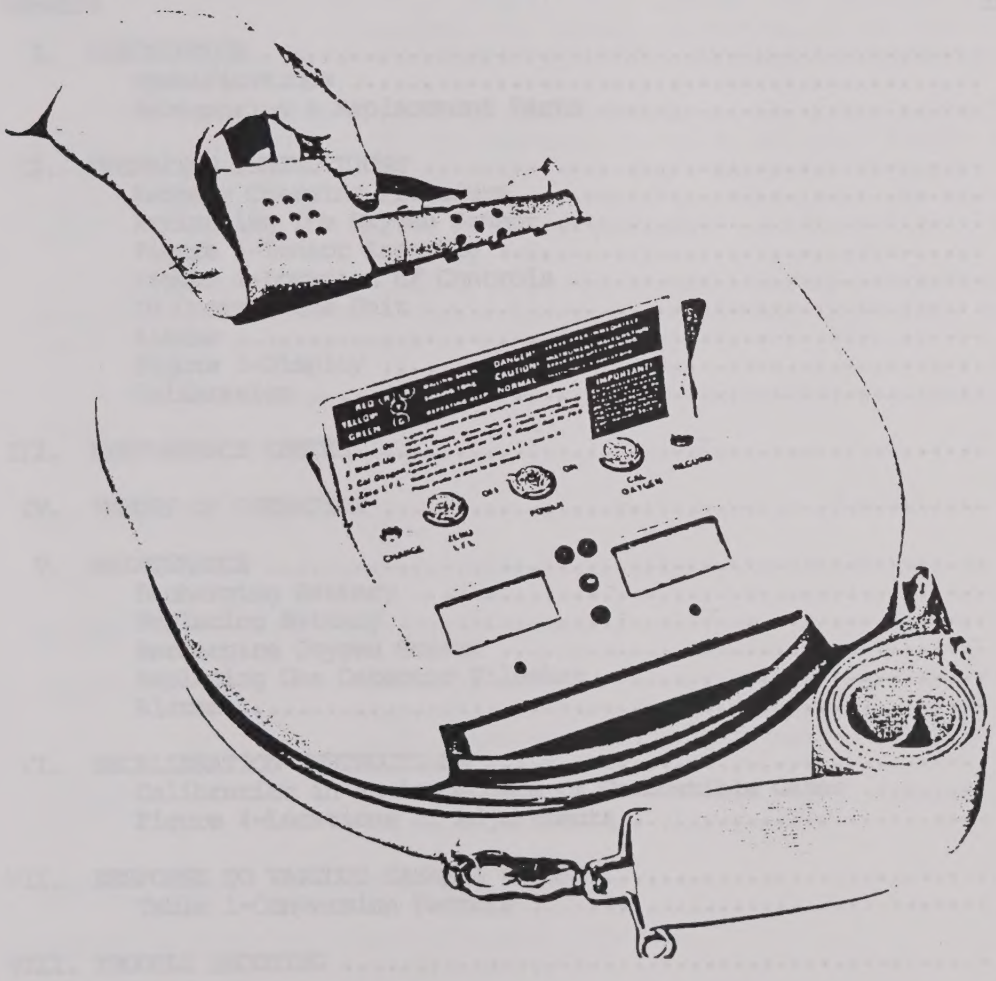
P/N 4564808

ECOLYZER®

NATIONAL DRAEGER, INC. 101 TECHNOLOGY DR. PITTSBURGH, PA. 15275 (412) 787-8383 TELEX: 866704

IMPORTANT WARNING!

This equipment must be operated in accordance with the manufacturer's instructions. All personnel responsible for the operation or maintenance of this equipment must read this instruction manual. Warranties made by Energetics Science for this instrument are voided if the instrument is not operated and serviced according to the instructions in this manual.



THE ECOLYZER PERSONAL COMBUSTIBLE GAS/OXYGEN MONITOR.

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SECTION I--DESCRIPTION

The ECOLYZER Combustible Gas/Oxygen Monitor is portable, battery powered, and designed to monitor a work area continuously for at least 8 hours. Audible and visual alarms warn workers of the presence of combustible gases or vapors and oxygen deficiency. They also indicate instrument malfunctions. The meters indicate explosibility in terms of L.F.L. (Lower Flammability Limit) and oxygen in percent of one atmosphere. L.F.L. represents the lowest concentration of gas in air which can be ignited by a source of ignition and cause an explosion.

A separate audible alarm is also provided in the probe assembly for remote warning. The unit also features a unique security "beep" which gives an audible indication that the instrument is operating. An internal control is provided to adjust the volume of the security "beep", or to turn it off if it is not desired.

The instrument is powered by a rechargeable nickel-cadmium battery pack which provides more than 8 hours of continuous operation, and is highly reliable and economical to maintain.

A built-in cable reel is provided for convenient storage of the 15-foot cable.

Specifications--Model 400

Size:	30.5cm (12") Diameter. 7.6cm (3") Thick.
Weight:	3.6 kg. (8 pounds).
Equipment:	Probe assembly on 15' cable, shoulder strap, oxygen sensor recharge kits, gas calibration kit, battery charger, sturdy foam-padded carrying case.
Battery:	8 cell 9.6 volt 4.0 Amp-Hour Nickel Cadmium rechargeable battery (furnished).
Battery Charge Life:	At least 10 hours.
Charger Voltage:	115/230 V.A.C., 50/60 Hz.
Charge Rate:	Overnight recharge (12-14 Hours).

	OXYGEN SENSOR	GAS DETECTOR
Detector:	Polarographic.	Catalytic Oxidation.
Measuring Range:	0-25% Oxygen.	0-100% L.F.L. (Methane Calibration Standard.)
Alarms:	Below 19.5%.	Above 20% L.F.L. (Adjustable)
Accuracy:	±0.2% Oxygen	±1% L.F.L. in 3 hours without rezeroing.
Response:	15 seconds	90% in 15 seconds.
Temperature Range:	-23°C to 82°C (-10°to 180°F) Internally temperature compensated from 15° to 50°C. (59° to 122°F).	-18° to 49°C. (0 to 120°F.)
Interfering Gases:	Concentrations higher than .25% (2500 ppm) of sulfur dioxide, fluorine, chlorine, bromide, iodine, and oxides of nitrogen.	Prolonged exposure to Tetraethyl Lead or Silicone vapors will cause loss of sensitivity.
Poisoning Gases:	Mercaptans and Hydrogen Sulfide in concentration of 1% or more.	

ACCESSORIES & REPLACEMENT PARTS

Replacement Battery Charger. 76009/4564011
Combustible Gas Detector Filament. 60-402/4564014
15' Extension Cable. 60-403/4564029
50' Extension Cable. 60-404/4564030
Accessory Carrying Case. 60-405/4564501
12-volt DC Adaptor. 4564016
Replacement Nicad Battery. (MSHA approved) 60-407/4564010
Sensor Assembly. 60-408/4564009
Calibration Kit. 60-460/4564022
Test Gas Cylinder Only. 60-461/4594843
Oxygen Recharge Kit -23°C to 82°C (-10°F to 180°F) 60-614/4564038
Sampling Accessory for smaller sampling ports 60-409/4564013

SECTION II—OPERATING INSTRUCTIONS

Before attempting to operate the unit be sure the batteries have been charged for at least 12 hours. The battery charger is factory set for 115 volt operation, and has an internal switch for conversion to 230 volt operation.

For 230 volt operation disassemble your battery charger by removing the bottom cover plate and move the switch to the 230 volt position.

NOTE: For 230 volt operation, a suitable line cord plug, or adaptor, must be provided by the user.

Battery Charging Procedure:

1. Make sure the power switch is in the OFF position.
2. Connect the charger plug to the charge jack on the instrument.
3. Plug the ECOLYZER Ni-Cad Battery charger into a suitable source of 115 V.A.C. (or 230 V.A.C.).

Charge the batteries for 12-14 hours. This will generate full capacity and the unit will operate continuously for more than 10 hours.

The unit may be operated while connected to the charger, however, the batteries will charge at a reduced rate.

CAUTION!

To prevent possible ignition of gases, recharge in a non-hazardous location.

Activating The Oxygen Sensor

Disassemble the probe assembly by sliding the shaft end of the probe off the body (See Figure 1). This exposes the oxygen probe for service. Using an ECOLYZER Oxygen Sensor Kit (60-614/4564038 = package of 10), charge the oxygen probe by this procedure:

1. Turn off monitor. Discard used cap.
2. Using scrubbing tool, scour silver until bright as a new dime. DO NOT abrade plastic parts of tip.
3. Fill new cap with electrolyte to vent holes.
4. Screw cap on finger-tight. Excess electrolyte will exude through vent holes.
5. Wipe off excess electrolyte. Discard used materials.

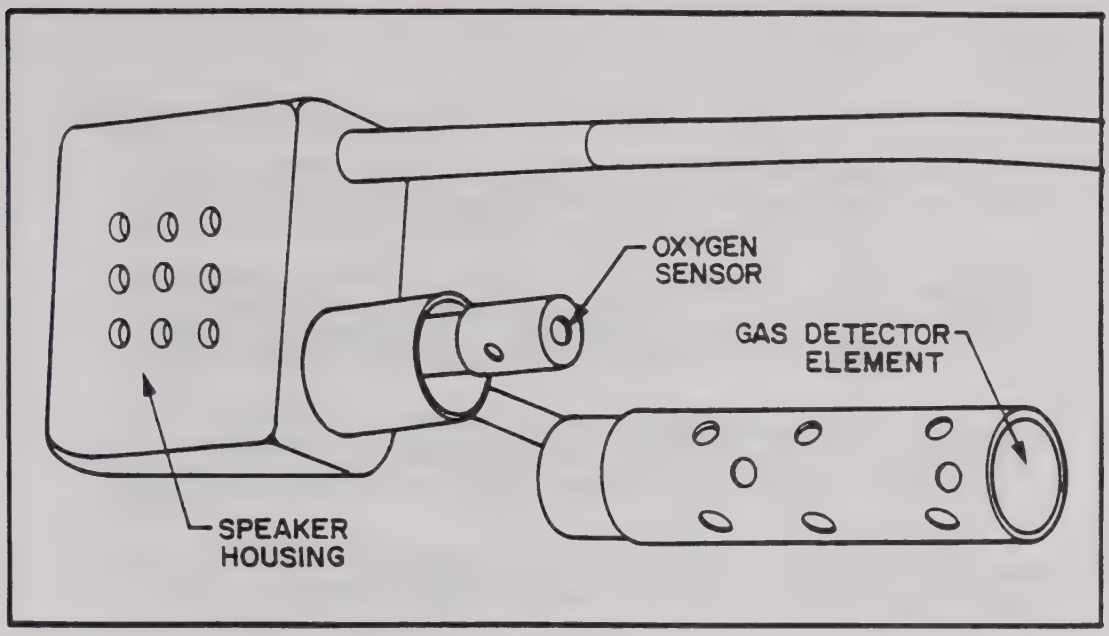


FIGURE 1 · SENSOR ASSEMBLY

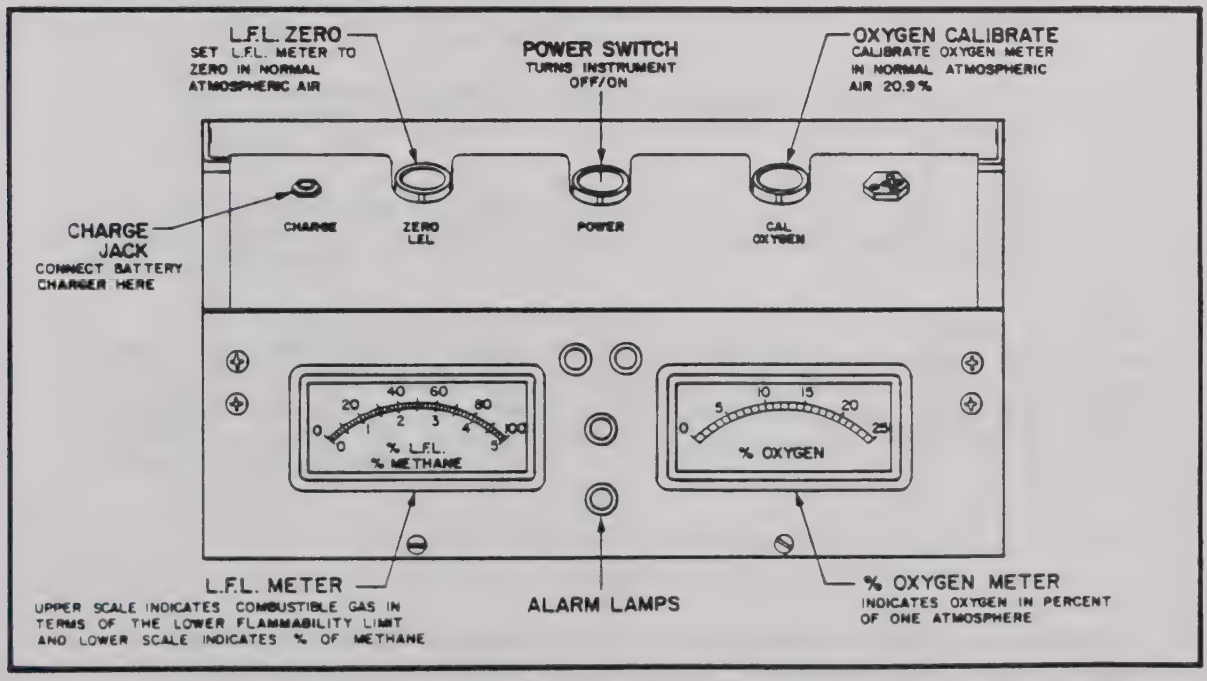


FIGURE 2 · LOCATION OF CONTROLS

To Operate the Unit:

1. Turn the power switch to the ON position. Both meters will indicate. Red, Yellow and Green lights and audible alarms will activate briefly, indicating they are operable.

2. Allow one minute for warm up. After one minute, the green light will come on to indicate that the unit is ready to be calibrated. DO NOT CALIBRATE OR ZERO UNTIL THE GREEN LIGHT COMES ON (approximately one minute).

3. With the Sensor Assembly in normal atmospheric air, calibrate the oxygen meter by rotating the CAL. OXYGEN control (See Figure 2) until the oxygen meter reads exactly 20.9% oxygen. (Ø symbol on meter.)

4. With the Sensor Assembly in gas free air, zero the % L.F.L. meter by rotating the ZERO L.F.L. control until the % L.F.L. meter reads exactly zero.

5. A short "beep" once every few seconds indicates the unit is functional. There is a control inside the unit to disable the security beep if it is not desired.

   NOTE: The security beep in NOT an indication that hazardous atmospheric conditions do not exist. To insure sensitivity to methane, the operator should perform the performance checks given in Section III. using METHANE test gas.

6. Place the probe assembly in the environment to be tested. If an ALARM occurs (red light and wailing siren), personnel should LEAVE THE AREA.

7. If an instrument malfunction occurs (yellow light and sinking audible tone), personnel should LEAVE THE AREA until the problem is corrected.

The shaft of the sensor assembly is 7/8" in diameter and will easily fit through a 1" sampling port. For smaller sampling ports, use a 60-409/4564013 Sampling Accessory. The 15-foot cable provides adequate extension for most applications. Longer accessory cable extension up to 200' are available. (15' Cable #60-403/4564029 - 50' Cable #60-404/4564030).

WARNING!

Do not attempt to operate the unit in oxygen enriched atmospheres. The hazard of explosion is greatly increased in high oxygen concentrations.

ALARMS

VISUAL DISPLAY

Visual information consists of a percent L.F.L. meter, a percent oxygen meter and an array of lights. SEE FIGURE 3.

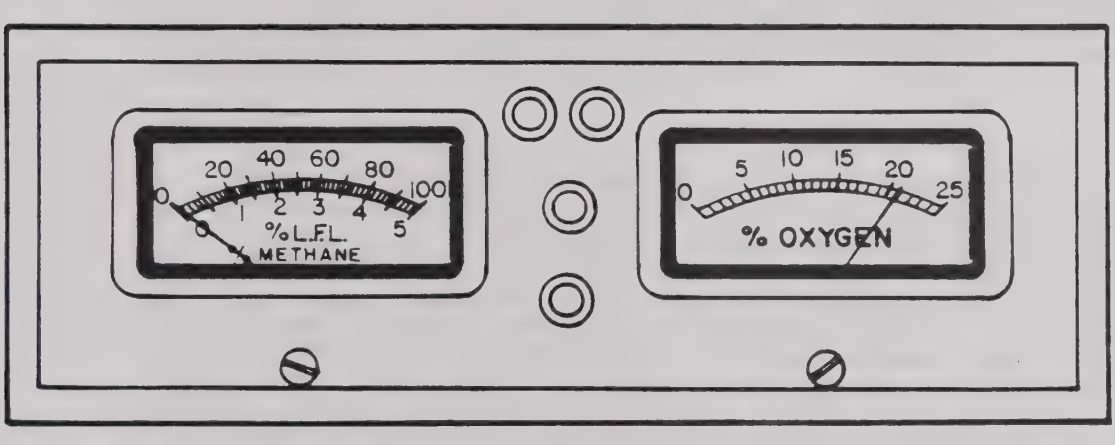


FIGURE 3—DISPLAY

The "Traffic Light" display gives an instant check of the instrument status:

RED: Alarm—High percent L.F.L. or low percent oxygen. LEAVE THE AREA!

YELLOW: Instrument Malfunctions:
1. Blinking: low battery
2. Continuous: defective gas detector element

CAUTION!! The instrument is no longer monitoring for combustible gas. The oxygen sensor, analyzer, and alarm section is still operable.

GREEN: Normal—The instrument is functional.

NOTE: The green light does not mean that hazardous conditions do not exist. The operator should perform the checks on alarm operation in Section III including a gas sensor test with METHANE test gas.

AUDIBLE ALARMS

A speaker is provided in the body of the unit and in the probe assembly to give an audible indication of environmental conditions and the instrument's status:

SIREN - DANGER! - Leave the Area
SINKING TONE - CAUTION!!! Instrument malfunction. The instrument is no longer monitoring for combustible gas.
SECURITY BEEP - NORMAL OPERATION - (A volume control is provided if this tone in not desired).

The audible and visual displays provide the operator with information to determine dangerous conditions or instrument malfunctions as well as proper operation of the instrument. The security "beep" and audible alarms are extremely valuable in situations where the operator cannot see the meters and lights.

LOW BATTERY ALARM

There is no battery test switch on this instrument. The circuitry of the No. 400 continuously monitors the condition of the nickel cadmium battery pack. The CAUTION! alarm is triggered when battery voltage falls below 8.4 volts. A freshly charged battery pack will provide more than 10 hours of operation before the CAUTION! alarm is triggered. The battery pack is further protected by circuitry which shuts off power to the gas detector filaments when the battery voltage goes below 8.4 volts. This helps prevent damaging "deep discharge," a major cause of battery failure. The instrument may indicate the CAUTION! alarm condition for several hours without damage to the battery pack. However, if left on, the battery pack will eventually be damaged by deep discharge. The operator should turn the unit off within two to three hours and recharge the battery pack.

COMBUSTIBLE GAS ALARM LATCH

When a high concentration of gas is present in concentrations greater than 90% L.F.L., the meter will latch up at full scale and stay there until reset. This latch shows the operator that a gas concentration near or exceeding the lower flammability limit has been sensed. In the latched condition, the siren alarm is on and power to the gas detector filament is turned off. This prevents possible damage to the filament from exposure to high gas concentrations. Resetting is done by turning the instrument off and waiting 15 seconds. When the instrument is turned on again it should go through its normal turn on sequence (see "Operating Instructions").

CALIBRATION

Oxygen

The oxygen portion of this instrument is calibrated by the operator against good air to 20.9%. Stability of this calibration is very good and it should be necessary to only calibrate the oxygen analyzer daily.

Gas

The combustible gas detector is calibrated at the factory. Meter indications are given in terms of % L.F.L. The abbreviations L.F.L. stands for Lower Flammability Limit, and represents the lowest concentration of gas in air which can be ignited by a source of ignition and cause an explosion. L.F.L. is also called the Lower Explosive Limit (L.E.L.). Model 400 is calibrated before shipment to indicate directly % L.F.L. of methane in air. The L.F.L. of methane is 5% by volume. That is, a concentration of 5% methane will indicate 100% L.F.L. Other combustible gases will be indicated approximately correctly in terms of explosibility. However, for maximum accuracy, calibration curves for various gases should be used. See Section VII, "Response to Various Gases."

Should calibration be necessary in the field, it may be accomplished using ECOLYZER Calibration Kit #60-460/4564022.

It is recommended that the gas detector be calibrated at least once every month, and whenever the detector filament is replaced.

See Section VI, "Recalibration Instructions" for calibration procedure.

Calibration in a Contaminated Atmosphere

Calibration may be easily accomplished in an atmosphere of combustible gases using ECOLYZER Calibration Kit 60-460/4564022. See Section VI, "Recalibration Instructions" for calibration procedure.

12 Volt Operation

Operation from 12 volt D.C. sources such as vehicle batteries is possible using ECOLYZER D.C. Adapter Model 4564016. Connect the D.C. adapter from the 12 volt outlet to the charge jack on the 400.

NOTE

When connected to a 12 volt automobile battery, the 400 batteries will charge at a reduced rate.

The 60-400 may be operated while connected to AC charger or 12 volt source. However, the 400 battery will charge at a greatly reduced rate.

SECTION III--PERFORMANCE CHECKS

For greatest reliability, the operator should perform these checks prior to each day's use of the instrument.

Turn on Sequence

Turn the unit on. The oxygen meter should indicate. The L.F.L. meter moves up and a 2 to 4 second siren verifies operation of the alarms. This is also an indication that the gas sensor is not open and the circuitry which senses an open gas sensor is operational.

After one minute the green lamp will come on to indicate a sufficient warm up time has elapsed.

Checking Oxygen Alarm

Calibrate the oxygen meter to the Ø mark at 20.9% in fresh air. Expose the sensor to gas flow from gas cylinder 60-461/4594843. The oxygen meter should move down below 19.5%, and the siren alarm and red lamp must come on. If they do not alarm at 19.5% oxygen, refer to Section V, "Maintenance."

Checking Gas Alarm

A suitable source of METHANE gas such as ECOLYZER Calibration Kit No. 60-460/4564022 is needed for this test. Methane is recommended for testing even if your unit is calibrated for another combustible gas such as hexane. All units, regardless of calibration should be tested with methane because probes poisoned by tetraethyl lead or silicones may not respond to methane even though sensitive to other combustible gases. To avoid this potentially hazardous condition the detector should be periodically tested with METHANE and MUST be tested after exposure to tetraethyl lead or silicones. The procedure for checking the gas alarm follows:

1. Turn the Monitor on and allow 15 minutes for warm up.

2. Expose the detector element to gas flow from the gas cylinder 60-461/4594843 (in ECOLYZER Calibration Kit No. 60-460/4564022).

3. The % L.F.L. meter must move up past 20% L.F.L. and the siren alarm and red light must come on. If the percent L.F.L. meter does not respond or responds very little, the detector element is poisoned and must be replaced. (See Section V, "Maintenance"). If the meter moves up but the alarm does not come on, the alarm must be adjusted. (See Section V, "Maintenance").

SECTION IV--THEORY OF OPERATION

Oxygen Detector

The oxygen sensor used in Model 400 is a polarographic sensor. It has a unique replaceable membrane assembly which allows quick and easy recharging of the probe.

The sensor consists of gold and silver electrodes enclosed by the membrane assembly in a potassium chloride electrolyte solution. Oxygen diffuses through the Teflon membrane and reacts with the KCL solution. The electrode reactions are:

Cathode: $O_2 + 2H_2O + 4_e^- \rightarrow 4\ OH^-$ Anode: $4A_g^+ + 4CI^- \rightarrow Ag\ Cl + 4e^-$

The current supplied by the cell is directly proportional to the oxygen present in the sample. This current is amplified and displayed on the % oxygen meter.

The ECOLYZER oxygen sensor measures the partial pressure of oxygen. The meter is calibrated to indicate 0 to 25% oxygen.

Tests indicate normal charge life of approximately 30 days. Oxygen readings which drift rapidly down scale or the inability to calibrate to 20.9% indicate the need to recharge. Recharging is accomplished with ECOLYZER Recharge Kit No. 60-614/4564038 (package of 10). See Section V, "Maintenance" for recharge procedure.

Temperature Limits: The Oxygen Sensor is internally temperature compensated from 15° to 50° C. (59° to 122° F.) Operation at temperatures between -2° to 15° C. (28° F. and 59° F.) requires that the meter be recalibrated with the sensor at the temperature of the sample. Use the following procedure:

1. Place the sensor in the atmosphere to be tested. Allow several minutes for temperature equalization.

2. Remove the sensor and quickly calibrate to 20.9% in good air.

3. Return the sensor to the atmosphere to be tested and read the % oxygen on the % oxygen meter.

Interfering Gases: Most commonly encountered gases will not affect or interfere with accurate readings of oxygen content when present in normal concentrations as found in industrial atmospheres. However, any gas permeable to the Teflon membrane and which can be reduced at 0.8 volts may add to the meter readings to the extent it is present. (Gases such as carbon dioxide do not reduce at 0.8 volts and will not affect the sensor regardless of concentration). The following gases will interfere when present in unusually high concentrations: sulfur dioxide, fluorine, chlorine, bromine, iodine and oxides of nitrogen. No one should enter a confined space in which such concentrations (as little as one quarter of a percent) of these gases are present without special respiratory protection.

Gas Detector

The detector element is the catalytic filament type. It consists of two platinum filaments, one of which is non-reactive, arranged in a bridge circuit. When a combustible gas contacts the heated filament, the heat from catalytic combustion causes a resistance change in the filament. This change is detected and displayed on the percent L.F.L. meter.

Temperature Limits: The operational temperature range is -18° to 49° C. (0 to 120°F.)

Poisoning Gases: Prolonged exposure to tetraethyl lead or silicone vapors causes poisoning of the filaments. Avoid leaded gasoline and silicone vapors. Testing of the gas detector element should be done with methane test gas. An element which responds to methane will respond to other combustibles. Elements which have reduced sensitivity or do not respond to methane are probably poisoned and must be replaced.

NOTE

The warning systems of the No. 400 give no indication of a poisoned filament. To detect a poisoned filament, the operator must test it with methane test gas.

Calibration

Calibration requires use of ECOLYZER Calibration Kit No. 60-460/4564022. See Section VI. "Recalibration Instructions".

SECTION V--MAINTENANCE

Recharging Nickel Cadmium Battery Pack (See Page 19) IN NON-HAZARDOUS AREA ONLY

1. Make sure the power switch is in the OFF position.
2. Connect the charger plug to the charge jack on the instrument.
3. Plug the ECOLYZER Ni-Cad Battery charger into a suitable source of 115 V.A.C. (or 230 V.A.C.).
4. Charge for 12 to 14 hours.

Replacement of Nickel Cadmium Battery Pack IN NON-HAZARDOUS AREA ONLY

The instrument must be disassembled for battery replacement.

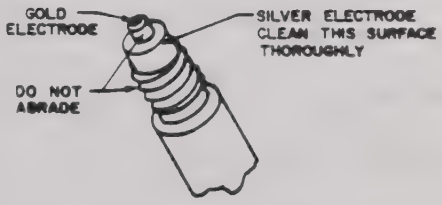
1. Disassemble the case by removing the five case retaining screws.
2. Disconnect the defective battery by pulling apart the connecting clip. Remove the defective battery.
3. Install a new MSHA approved (Catalog #60-407/4564010) battery pack and connect with connecting clip. Reassemble the case.
4. Charge for 12 to 14 hours.

Recharging Oxygen Sensor

Normal charge life is approximately 30 days. Oxygen readings which drift rapidly down scale or the inability to calibrate to 20.9% indicate the need to recharge the oxygen sensor. Recharging is accomplished with ECOLYZER Recharge Kit #60-614/4564038. Use the following procedure:

Recharging Procedure

1. Make sure the instrument is OFF.
2. Disassemble the probe assembly by sliding the shaft away from the body to uncover the oxygen sensor. (See Figure 1).
3. Unscrew and discard the used cap.
4. Using the tissue from the kit, wipe away residual electrolyte.
5. Using the green scrubber, scour the silver electrode until bright as a new dime. Do not abrade plastic parts of tip.
6. Fill the new cap with electrolyte to vent holes.
7. Screw the cap on finger-tight. Excess electrolyte will exude through vent holes.
8. Wipe off excess electrolyte. Discard used materials. Allow two minutes to stabilize, then recalibrate.



Replacing Gas Detector Filament 60-402 IN NON-HAZARDOUS AREA ONLY

A CAUTION! alarm accompanied by a steady yellow light indicates that the gas sensor filament is burned out and must be replaced. If the filament gives no response to methane test gas or its response is greatly reduced, the filament is probably poisoned and must also be replaced. The detector assembly should be replaced if ZERO cannot be set within range of the ZERO L.F.L. control, or if the % L.F.L. meter cannot be calibrated using the L.F.L. CAL control (See figure 4).

Procedure:

1. Make sure the instrument is OFF.
2. Disassemble the probe assembly by sliding the shaft away from body.
3. Remove three wires from the filament assembly and pull out the old filament assembly.
4. Install a new filament assembly 60-402/4564014.
5. Attach wires (black to black, white to white, blue to blue). Reassemble.

See Section VI. "Recalibration Instructions" for Calibration Instructions.

Alarms

Adjusting Oxygen Alarm

Set oxygen meter, using the CAL OXYGEN control, to 19.5%. Adjust O_2 Alarm Level control (See figure 4) until the alarm just comes on. Rotate the calibrate control above and below 19.5%. The alarm should just come on at 19.5%.

Adjusting Gas Alarm

The alarm point may be adjusted to any point on the meter scale.

1. Turn the unit ON. Allow 15 minutes for warm up period.
2. Adjust the Zero L.F.L. control until the L.F.L. meter indicates the desired alarm point. (Factory set at 20% L.F.L.)
3. Adjust the L.F.L. Alarm Level control (See figure 4) until the alarm just comes on at 20% L.F.L. (or any desired alarm point).

Security "Beep"

The security volume control (SEC VOL-See figure 4) adjusts the volume of the security beep from full off to maximum. Set control for the desired volume.

SECTION VI--RECALIBRATION INSTRUCTIONS

A. The oxygen analyzer section of this instrument is calibrated by the operator to 20.9% in good air. Special calibration Procedures are not necessary. With the Sensor Assembly in good air, calibrate the oxygen meter by rotating the CAL. OXYGEN control (See Figure 2) until the oxygen meter indicates exactly 20.9% oxygen, (Ø Symbol on Meter.)

B. The gas detector section of this instrument requires periodic calibration with a standard gas sample. The ECOLYZER Calibration Kit #60-460/4564022. Use the following procedure:

1. Disassemble case by removing the five retaining screws.
2. Allow the instrument to warm up for 15 minutes.
3. Assemble the calibration gas tank and delivery tube.
4. Carefully open the valve on the gas tank to bathe the sensor with just enough gas to cause the needle on the L.F.L. meter to move.
5. Adjust the L.F.L. CAL control (See figure 4) until the percent L.F.L. meter indicates exactly the correct L.F.L. as shown on the calibration gas cylinder.

Calibration In An Atmosphere of Combustible Gases

Calibration in an atmosphere of combustible gases requires a source of methane test gas (supplied in ECOLYZER Calibration kit, #60-460/4564022) and a source of compressed air.

Procedure:

1. Using compressed air, bathe the gas sensor in a flow of air and adjust the ZERO L.F.L. control until the % L.F.L. meter indicates exactly zero.
2. Calibrate the oxygen meter by rotating the CAL. OXYGEN control until the oxygen meter indicates 20.9%.
3. Using the methane test gas, bathe the sensor in a flow of test gas and calibrate, if necessary, by adjusting the L.F.L. CAL control. (See Figure 4.)

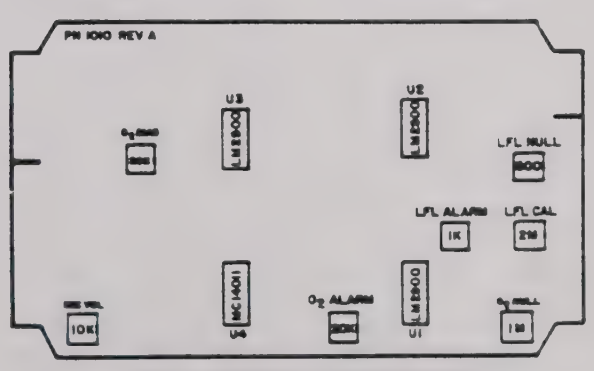


FIG.4-LOCATION OF ADJUSTMENTS

SECTION VII--RELATIVE RESPONSE TO VARIOUS GASES & VAPORS

Although the instrument is calibrated to indicate in % L.F.L. of methane, other combustible gases/vapors are also monitored effectively. Worker protection is afforded, since the alarm will sound with a significant margin of safety, or safety factor, before a hazardous condition is reached.

Conversion Factors are given in Table 1 to convert a meter indication to the % L.F.L. of combustible gases/vapors other than methane. The meter indication is divided by the Conversion Factor to obtain the actual % L.F.L. of the gas/vapor being measured.

The Conversion Factor takes into account the L.F.L. of the gas/vapor being measured, and the detector's sensitivity to it.

Example:

The atmosphere being measured is known to be a butyl alcohol-air mixture. The meter indication is 20% L.F.L., and the alarm sounds. To determined the actual amount of butyl alcohol present, divide the meter indication by .30, which is the Conversion Factor for butyl alcohol.

20% L.F.L. indicated - .30 = 66.7% of the L.F.L. of butyl alcohol.
Safety Factor = 1.5 which is obtained by dividing 66.7% into 100%.

Safety Factor:

The Safety Factor is an indication of how far the atmosphere being measured is from a hazardous condition (100% L.F.L.). A higher Safety Factor indicates a greater margin of safety.

To recalibrate the instrument to indicate directly the % L.F.L. of a specific gas/vapor other than methane, the Recalibration Instructions in Section VI, must be followed. However, a known mixture of that gas/vapor must be used instead of the 60-460/4564022 Calibration Kit, which contains methane.

TABLE 1

Gas/Vapor	LFL	Conversion Factor	% LEL At Alarm (20%)	Safety Factor
Acetone	2.1	0.59	33.9	3.0
*Acetylene	2.5	--	--	--
Benzene	1.4	0.43	46.5	2.2
*Butadiene	2.0	--	--	--
Butane	1.9	0.72	27.8	3.6
Butyl Alcohol	1.4	0.30	66.7	1.5
Ethane	3.0	0.84	23.8	4.2
Ethylene	3.1	0.68	29.4	3.4
Heptane	1.2	0.46	43.5	2.3
Hexane	1.2	0.45	44.4	2.2
Hydrogen	4.0	0.98	20.4	4.9
Isopropyl alcohol	2.0	0.51	39.2	2.6
Kerosene	(Assume equivalent to Heptane)			
Methane	5.0	1.00	20.0	5.0
Methanol	6.7	0.97	20.6	4.8
MEK	1.8	0.51	39.2	2.6
Pentane	1.4	0.60	33.3	3.0
Propane	2.2	0.73	27.4	3.6
Propyl alcohol	2.0	0.51	39.2	2.6
Propylene	2.0	0.45	44.4	2.2
Styrene	1.1	0.31	64.5	1.6
Toluene	1.3	0.38	52.6	1.9
Xylene	1.0	0.33	60.6	1.6

*response to acetylene and butadiene may be quite variable from one sensor to another. Consult factory if reliable indication of the vapors is a requirement.

SECTION VIII--TROUBLE SHOOTING

Basic trouble shooting procedures are given in this section. If service is required beyond these basic procedures, refer the problem to qualified personnel.

Symptom	Cause	Remedy
No Meter Indication No alarms	Dead or defective battery	Recharge or replace battery
Constant oxygen alarm Unable to calibrate to 20.9%	Defective oxygen probe	Recharge oxygen probe
Does not operate for full 8 hours	Defective battery pack	Recharge or replace
Caution! Alarm, blinking yellow	Low battery	Recharge battery
Caution! Alarm, steady yellow	Burned out gas detector filament	Replace filament, and recalibrate
Red and Yellow Lamps only	Improperly connected extension cable, or probe cable not connected. Very low battery	Connect probe cable. Make sure extention cable connectors make good connections. Recharge

SECTION IX--WARRANTY

NATIONAL DRAEGER
INSTRUMENT WARRANTY POLICY

National Draeger guarantees each unit for six months from the date of purchase. During this period, any parts found to be defective in materials or workmanship upon examination by National Draeger will be replaced at no charge to the customer, provided that:

1. Unit has been properly registered with National Draeger.
2. Unit has been operated in accordance with our instructions, and that there is no evidence that the unit has been subjected to damage or abuse.
3. Any prior repair services were performed only by National Draeger or a qualified National Draeger representative.

Transportation charges and insurance for the warranted unit shall be prepaid by customer when sending to National Draeger. National Draeger will pay return transportation and insurance charges.

This warranty assumes normal usage, and does not include batteries recharge, or sensor recharge. It shall not include and liability or obligation directly or indirectly resulting from the defective unit nor any associated delays. The foregoing warranty is exclusive and in lieu of all other warranties expressed or implied.

(Rev.-6/79)

SECTION X--RETURNING YOUR 400 FOR SERVICE

Contact customer service department at National Draeger for return authorization. Instruments returned to the factory for repair should be sent, freight and customs prepaid to:

National Draeger
Repair Department
101 Technology Drive
Pittsburgh, PA 15275

Repair Center Telephone Number: (412) 787-8383; Telex 866704.

Please include a return authorization number, description of the complaint and your name and address or P.O.

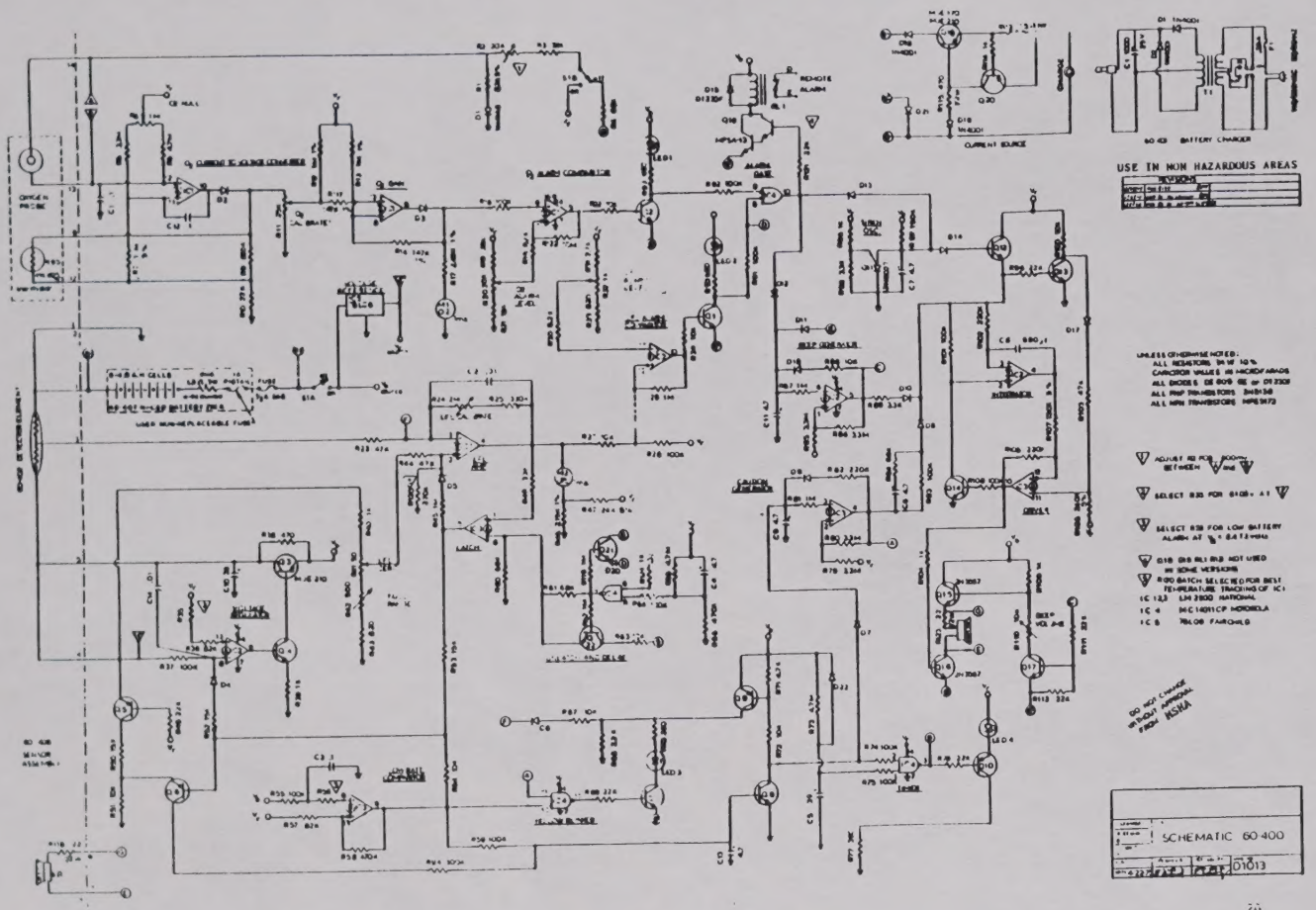
THE CARE AND FEEDING OF NICKEL CADMIUM BATTERIES

To assure the maximum useful life of a rechargeable Nickel Cadmium battery, an owner should take special care in its use and maintenance. Energetics Science recommends the following:

1. DO NOT overcharge. Normal charge time is 12-14 hours (overnight). Batteries may remain on the charger for a longer period of time, but, continuous charging for more than a week should be avoided.

2. DO NOT allow batteries to become completely discharged. A dead battery (state of deep discharge) can probably be recharged several more times, but early failure is highly likely. (Energetics Science instruments are designed to warn owners of a low battery condition).

3. DO charge batteries that have not been in service. Batteries in storage should be charged at least every 60-90 days.


USE IN NON HAZARDOUS AREAS
SCHEMATIC 60400
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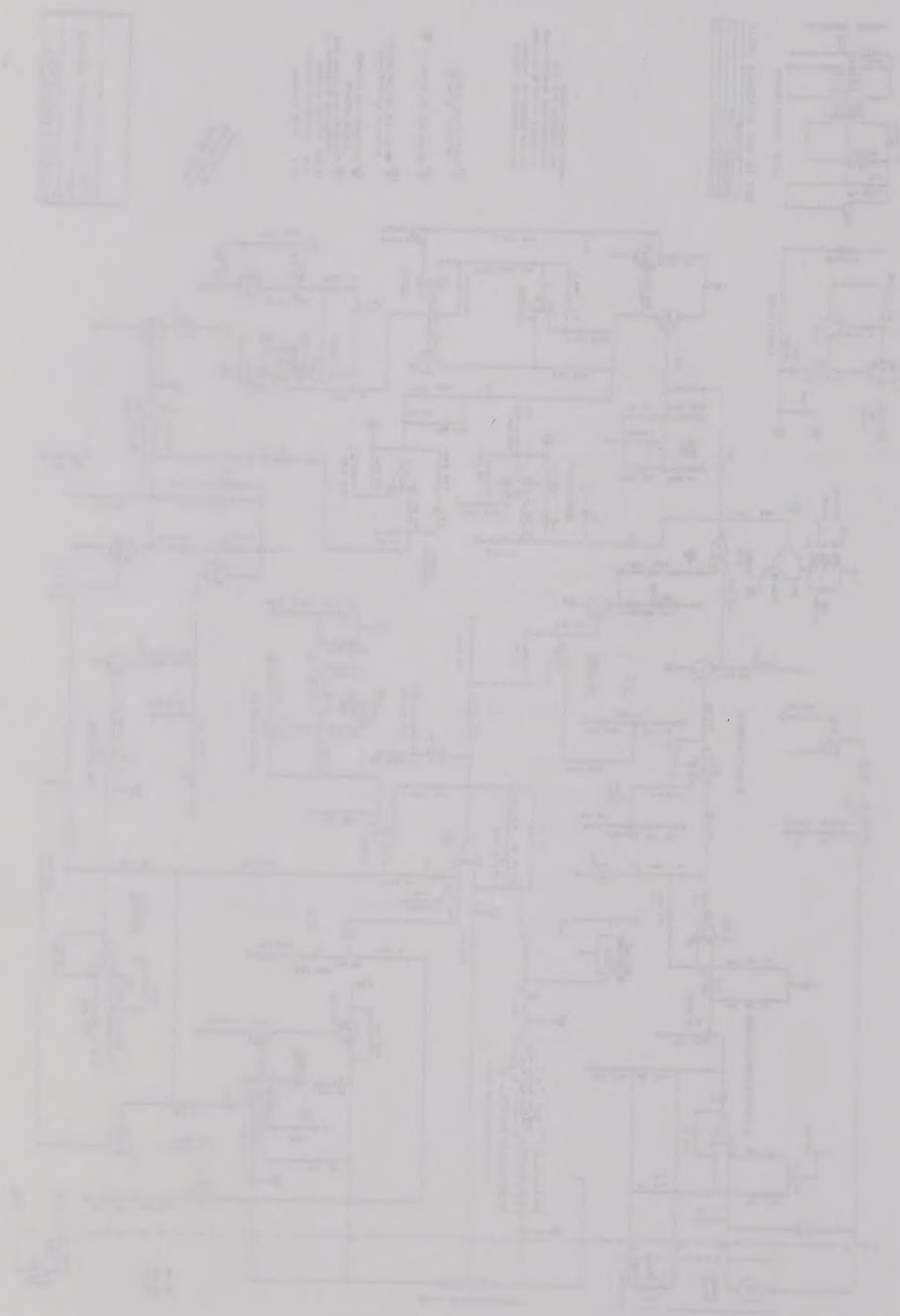

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